(12) UK Patent Application (19) GB (11) 2 386 317 (13) A

(43) Date of A Publication 17.09.2003

(21) Application No 0305494.7

(22) Date of Filing 11.03.2003

(30) Priority Data
(31) 0205835 (32) 13.03.2002 (33) GB
(31) 0214189 (32) 20.06.2002
(31) 0223240 (32) 08.10.2002

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(51) INT CL^7
B26D 7/04 5/42

(52) UK CL (Edition V)
A4C CR CUW C135

(56) Documents Cited
US 4583435 A

(58) Field of Search
UK CL (Edition V) A4C, B8A
INT CL^7 B26D, B65G
Other: Online: EPODOC; WPI; PAJ

(54) Abstract Title
Slicer with a claw which passes through a gap in a conveyor

(57) Claws 53, 55 are located in the gap between two conveyor sections 74, 76 a short distance upstream of a rotating blade (16, figure 4). Claws 53, 55, 57, 59 are driven into the food 12, 14 and retracted before the claws reach the blade. Sensors 84, 86 upstream of the blade detect the leading and trailing edges of the foodstuff. The claws 53, 55, 57, 59 are controlled in response to the calculated distance travelled by the food 12, 14 and the blade position. Preferably a controlled conveyor (92, figure 4) removes the sliced bacon (18, figure 4). Preferably the connected claws 53, 55, 57, 59 are pneumatically driven and apply a force that resists excessive forward motion. Preferably the food 12, 14 is gripped between upper 74, 76 and lower 10 conveying means, as it is fed towards the bacon slicer. The food may be gripped by spikes entering it from both above and below.

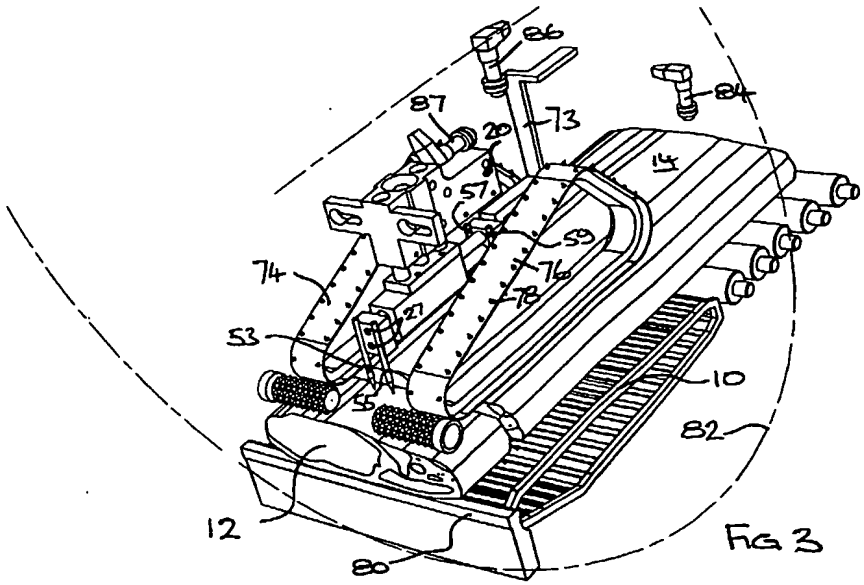

Fig 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

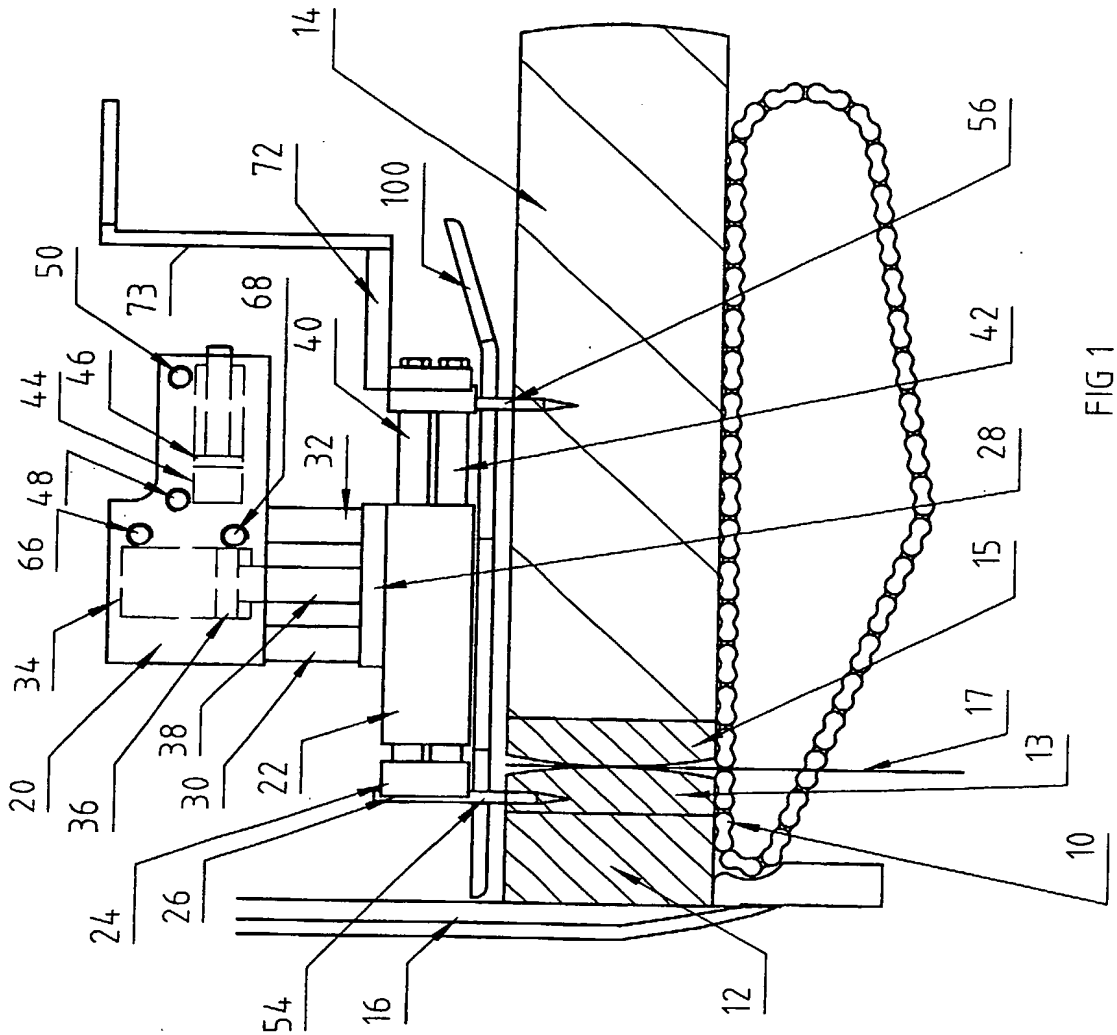
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FIG 1

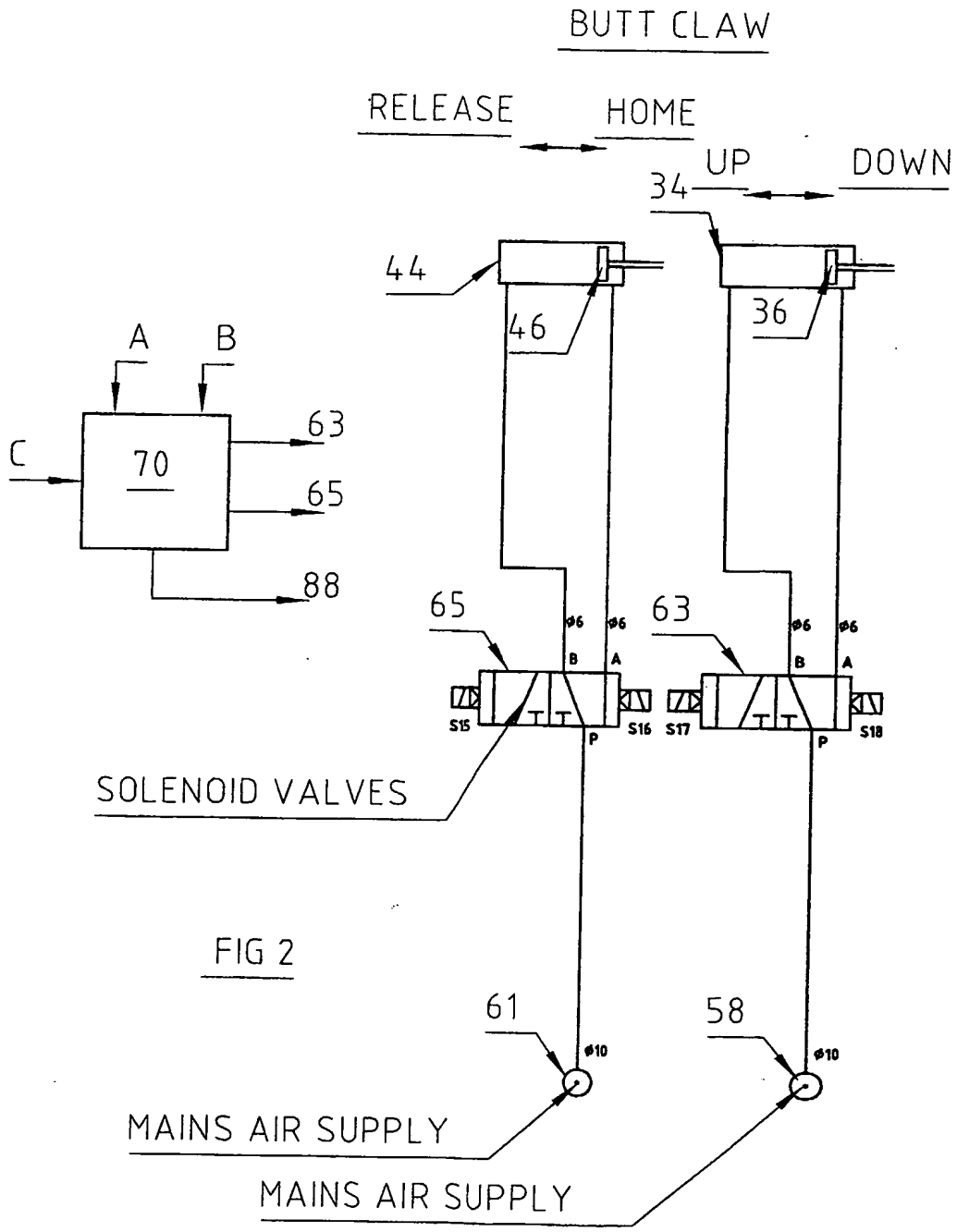
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FIG 2

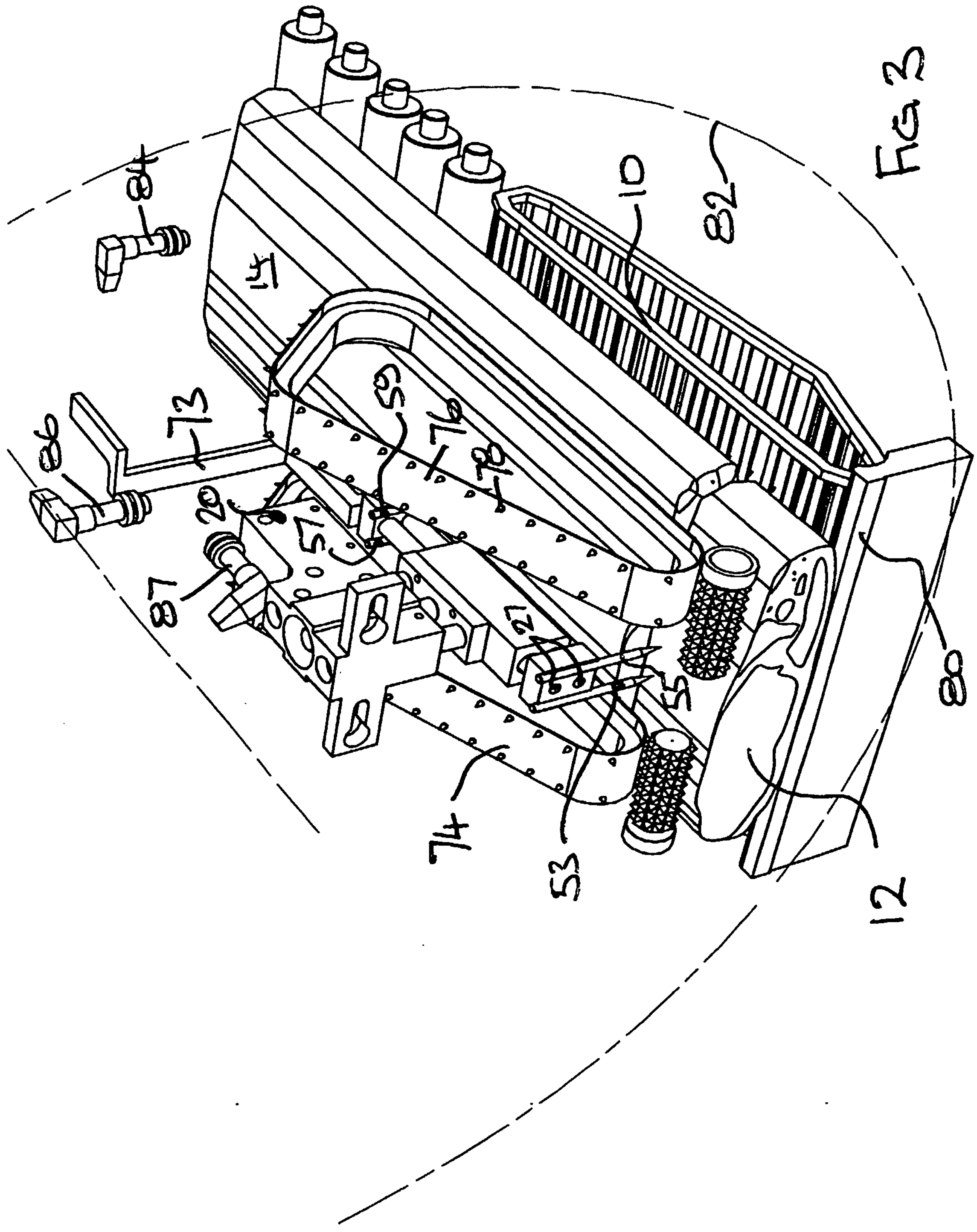

Fig 3

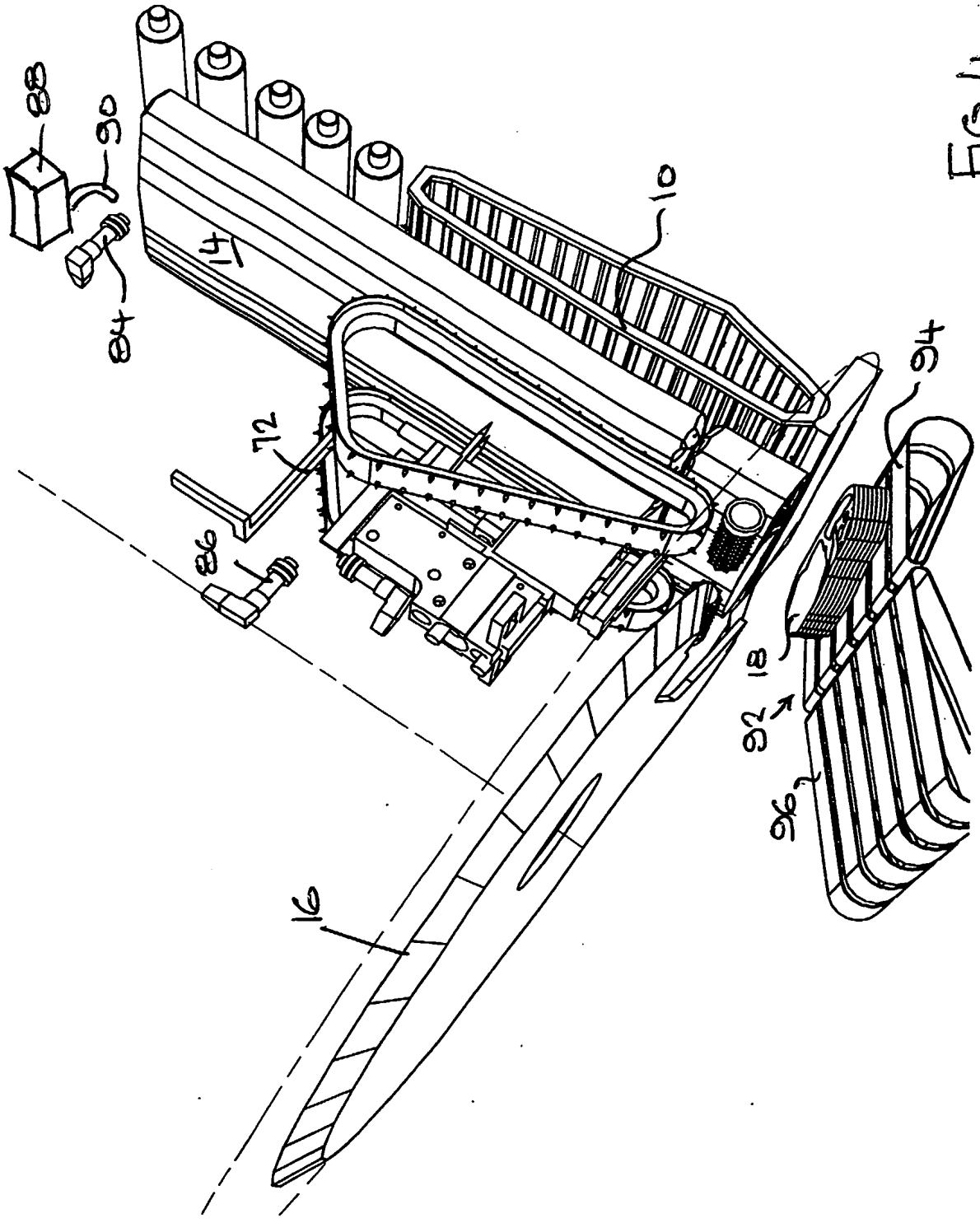

Fig 4

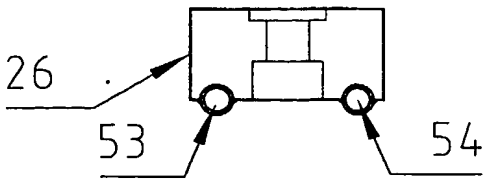

FIG 6

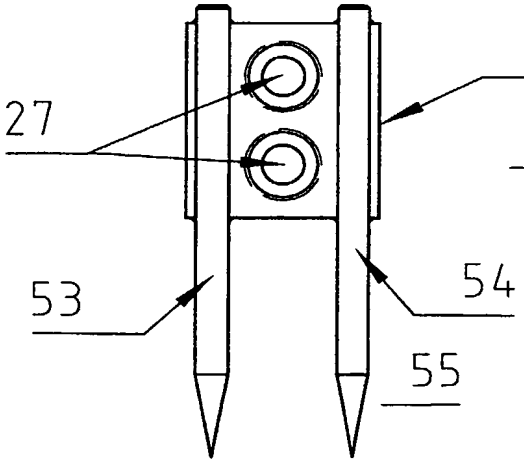

FIG 5

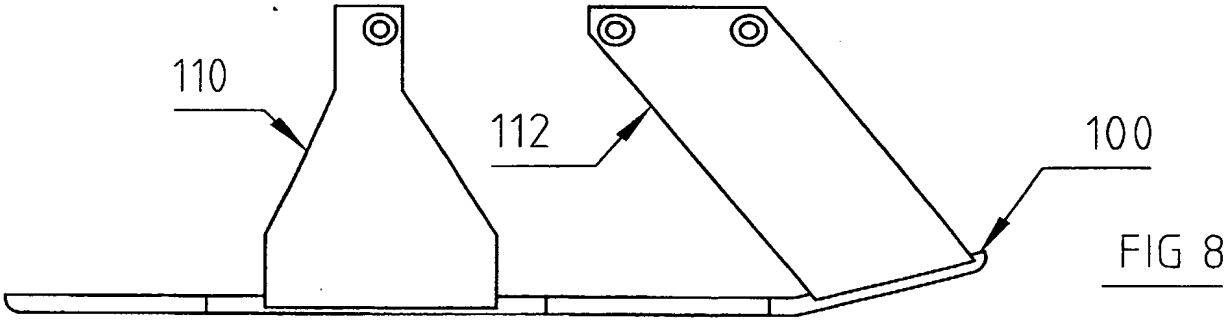

FIG 8

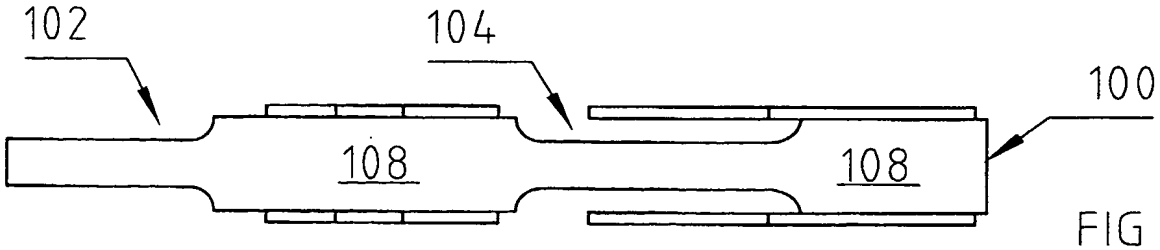

FIG 7

C1120/A

Title: Improvements in and relating to slicing machines

Field of the invention

This invention concerns slicing machines, especially but not exclusively food slicing machines such as bacon slicing machines

Background to the invention

In conventional apparatus as described in US 5,079,982 the upper and lower conveyors grip the side of bacon from above and below, and feed it towards a rotating blade, to remove thin slices (rashers) from the leading end of the meat as it is advanced through the slicing station. Typically the cross section of a side of bacon is asymmetric throughout much of its length. The gripping force exerted on a side of bacon, and therefore the traction force exerted on the meat if the conveyors are both single and flat, will be applied to that part of the cross section which has the largest dimension (measured perpendicular to the run of the conveyors), since it is that region of the cross section which will determine the spacing between two such conveyors. Where (as is usual in the case of bacon), this is offset from the mid-way point across the width of the side of bacon, and in some cases can be virtually coincident with the left or right end of the cross section, as viewed normal to the end that is being sliced, the result is that the traction force acting on the meat is well displaced from the mid position of the cross section. This can result in a twisting action on the meat, especially as the remaining unsliced length of each side of bacon becomes smaller and smaller as more of it has been sliced into rashers.

US 5,079,982 describes an upper conveyor which is divided into four separate sections to assist in overcoming this problem. However this is relatively complex and presents difficulties when trying to clean the machine.

When using upper and lower continuous conveyors to carry a side of bacon towards the rotating blade to remove the thin slices from its leading, the last part of each length of meat (the butt end or tailpiece) tends to become unsupported by the conveyor means, causing it to fall into the blade and be wasted.

It is an object of the present invention to provide an improved apparatus and method which overcomes this problem.

In such a bacon slicing machine it is desirable to abut the leading end of the next side of bacon up to the trailing end of the side being sliced, so as to provide rear support for the latter, especially as it reduces in length towards the end of the slicing process. However this abutting of one side against the next can obscure the trailing end of the first side of bacon, since it becomes merged with the following piece of meat.

It is therefore another object of the present invention to provide an improved control system for a foodstuff slicing machine which overcomes this problem and allows the position of the trailing end of a length of foodstuff which is being sliced ahead of an immediately following length to be precisely known.

It is a further object of the invention to provide an improved method and apparatus for gripping and feeding an asymmetrical cross section length of meat towards a slicing station and presenting the end of the uncut section of the meat squarely to the slicing station.

Conventional slicing machines tend to mount the blade in the slicing station so that its cutting plane is approximately 20° to the vertical, and present the foodstuff at a similar angle. This can lead to problems in stacking the cut slices.

It is a further object of the present invention to provide an improved slicing station in a foodstuff slicing machine used as a bacon slicer, which assists in the stacking of slices post slicing, especially where stacks in excess of six slices are required.

Summary of the invention

According to one aspect of the present invention there is provided a slicing machine including a slicing station containing a rotatable blade for slicing blocks of foodstuff, wherein transport means is provided for gripping and moving the foodstuff blocks in a forward direction towards and through the slicing station which transport means comprises two part conveyor means adapted to grip blocks of foodstuff therebetween to move them towards the slicing station, one part including spaced apart sections defining a gap which will be substantially midway of a block of foodstuff when the latter is gripped between the two parts, and a movable claw is located upstream of the blade, and a drive means therefor is adapted to move the claw through the gap in one direction to engage a surface of a foodstuff block, and in the opposite direction clear of the block when not required, to provide when so engaged tail-end support for the block during slicing.

Preferably the claw drive means is controlled so as to move the claw into contact with the tail-end region at the rear end of a block of foodstuff, as the tail-end approaches the blade during operation of the machine.

In order to avoid the claw entering the trajectory of the blade, the claw is adapted to travel with the tail-end in a direction towards the blade until the claw is just upstream of the blade, at which point the claw drive means is controlled to operate in an opposite sense to withdraw and retract the claw.

The drive for the claw is preferably pneumatic.

In a preferred arrangement the claw drive comprises two pneumatic drives, in which one of the drives serves to drive the claw towards and away from a block of foodstuff between the two parts of the conveyor means and the second serves to exert a rearwardly directed force on the claw.

Preferably the rearwardly directed force on the claw as the latter is advanced towards the blade is less than the tractive force exerted by the conveyor means but sufficient to resist the tendency for the blade to tear the tail-end of the foodstuff out of the conveyor means.

Preferably the rearwardly directed force is increased in magnitude when the claw is moved clear of the tail-end so as to accelerate the claw backwards away from the blade.

The machine may further comprise a second similar claw adapted to engage an opposite face of the foodstuff block, and the conveyor means also defines a second gap through which the second claw can protrude.

Typically a drive for the second claw is controlled to move it through its gap to engage the said opposite face of the block, at the same time as the first claw is moved in a direction to engage the other face of the block.

The or each claw may comprise a single foodstuff engaging element, which may have two prongs spaced apart in a direction perpendicular to the movement of the foodstuff so as to engage two spaced apart regions of the foodstuff, to provide better support of the tail-end region of the block as it progresses towards the blade.

The or each claw may comprise two such elements, one located upstream of the other, spaced apart in the direction of foodstuff travel, the spacing between the elememts being such that the downstream elememt will engage the tail-end of a foodstuff block being sliced, and the upstream element will engage the following block of foodstuff just behind the leading face thereof, thereby tying the tail-end of the former to the leading end of the latter, so as to provide further support for the tail-end as it progresses towards the blade.

The second element is preferably rigidly connected to or integrally formed with the first.

The two part conveyor means may comprise upper and lower conveyor means and the upper conveyor means comprises two separate conveyors.

The two separate conveyors making up the upper conveyor means may be relatively displaceable in at least a direction generally perpendicular to the plane of the lower conveyor means, so as to accommodate different thicknesses of foodstuff on either side of the gap.

Resilient displacement means may be provided for separately urging the two upper conveyors independently of each other in a direction towards the lower conveyor.

The displacement means typically exerts substantially the same force on each of the two conveyors, so that the two conveyors squeeze the foodstuff between the upper and the lower conveyor means with substantially the same force on each side of the said gap.

Preferably each of the upper conveyors is driven from one rotational drive means so that both rotate at the same speed so as to advance foodstuff in a generally uniform manner towards the blade.

Preferably the lower conveyor means is also driven from the said one rotational drive means

A machine embodying the invention preferably also comprises a control system for controlling the operation of the machine using signals which identify the positions of the leading and trailing ends of blocks of foodstuff to be sliced thereby, together with signals indicating the linear advance of each block derived from the movement of the conveyors.

Preferably the machine includes a sensor upstream of the slicing station to provide a first signal when the leading end of a first block of foodstuff to be moved towards the blade passes the sensor, and to provide a second signal when the trailing end of that first block passes the sensor, the first and second signals being supplied to the control system.

According to a preferred feature of the invention the machine further comprises an escapement under the control of the control system, which escapement operates so as only to allow a subsequent block of foodstuff to move up to and abut the trailing end of a preceding block of foodstuff after the trailing end of that preceding block has passed the sensor and a second signal has been produced by the sensor for that preceding block.

Typically the line of travel of the foodstuff blocks gripped by the conveyor means is at 90° to the plane of rotation of the blade, and the latter subtends an angle of approximately 60° to the vertical.

Preferably a so-called twin jump conveyor is provided beyond the blade to collect and remove stacks of slices as soon as they are formed downstream of the blade.

Preferably the air to the second pneumatic claw drive is supplied at a first pressure while the claw is engaged with the foodstuff and is moving forward therewith, and is supplied at a second substantially higher pressure after the claw has been disengaged and is to be retracted to its start position.

Two sources of air pressure may be provided, one high and the other low, and valve means is provided to connect the second pneumatic drive to the low-pressure source during the forward movement of the claw, and to the high-pressure source during the return movement.

The valve means may comprise separate ON/OFF valves or a three-way valve which connects the second pneumatic drive to one or the other of the two sources of pressurised air in its first and second positions, and vents to atmosphere in its third position.

Each source of air pressure may be adjustable to deliver an appropriate pressure to the second claw drive.

A single high pressure air source may instead be employed, and the latter is selectively connected to the second claw drive by valve means either directly (when the higher pressure is required) or via a pressure reducing valve (when the lower pressure is required).

The pressure-reducing valve may be adjustable to allow the reduced pressure to be adjusted to a desired value.

Preferably a control system is provided which controls the operation of the feed conveyor means, the slicing blade, the engagement and withdrawal of the claw, and the feeding of blocks of foodstuff product, and is also adapted to control the valve means synchronously with operation of the machine and particularly the movement of the claw.

Preferably the second claw drive comprises a single acting air cylinder, and lower and higher air pressures are supplied to one end thereof, the lower pressure providing a cushion of air compressible by movement of the piston in the cylinder as the foodstuff block advances towards the blade and drags the claw with it, and the higher pressure serving to return the piston towards the opposite end of the cylinder after the claw has been disengaged from the block by the first claw drive.

According to another aspect of the invention there is provided a method of slicing a succession of lengths of foodstuff using a rotating blade in a slicing station, wherein a first conveyor means incrementally moves the foodstuff by applying a tractive force F_1 thereon towards the blade so as to cause successive parts of the foodstuff to protrude into the path of the blade so as to be severed therefrom as the blade passes therethrough, and a second conveyor means collects the slices of foodstuff and conveys them away from the slicing station, comprising the further steps of:-

(1) sensing when the leading edge of a length of foodstuff to be sliced passes a given position along the path of the first conveyor means upstream of the cutting station and generating a leading edge signal,

(2) sensing when the trailing edge of the same length of foodstuff also passes the said given position, and generating a trailing edge signal, to allow the length to be computed,

(3) computing the length of the foodstuff being sliced from the distance travelled by the first conveyor means after the leading edge signal,

(4) determining from the computed length value and the movement of the conveyor means, when the trailing edge is a distance of N mm upstream of the blade trajectory,

(5) driving a claw through a gap in the first conveyor means at a position Mmm ($M < N$) upstream of the blade to engage and thereafter move with the foodstuff, and

(6) sensing the position of the claw and retracting it from the foodstuff before the claw reaches the blade.

Preferably the claw is pneumatically driven towards and away from the foodstuff.

Preferably pneumatic force is also employed to move the claw rearwardly away from the foodstuff.

The invention may comprise the further step of applying a force F_2 to resist the forward motion of the claw towards the blade, where F_2 is less than F_1, so that there is still a net force acting on the foodstuff to incrementally move it towards the blade.

Conveniently the leading and trailing edges of each length of foodstuff are detected using a laser beam and a photosensitive device.

Preferably a following length of foodstuff is prevented from moving into abutment with the trailing end of the length being sliced until after the trailing edge of the latter has been detected.

The method may also include the step of successively lowering the second conveyor means relative to the blade as slices of foodstuff are deposited thereon, so as to enable a plurality

of slices to be stacked one above the other on the second conveyor means so that the upper end of the stack does not prevent the slices from leaving the blade and falling onto the stack.

Conveniently the second conveyor means is operated to convey a stack of slices away from the region of the blade when a predetermined number of slices P, or a given weight of foodstuff W, has been accumulated thereon.

Preferably a counter counts the number of slicing cuts by the blade and resets when P is reached, and the resetting of the counter triggers the second conveyor means to move the stack laterally away from the blade.

Alternatively a weighing device may be associated with the second conveyor means and the latter is operated to move the foodstuff laterally away from the blade when the weight detected by the weighing device reaches W.

Typically the second conveyor means is in two parts and one part acts to collect slices until the P or W criterion is reached, whereafter a second part takes over to collect slices from the slicing station while the first part conveys away the stack of slices accumulated thereon, the two parts alternating in synchronism to allow a substantially continuous stream of slices from the slicing station to be handled.

The method may include the further step of moving a second claw into contact with the foodstuff at the same time as the first claw engages the foodstuff, the second claw also moving with the foodstuff, and also being retracted away from the foodstuff before the claw reaches the blade.

The second claw may be moved into contact with the foodstuff through the same gap in the first conveyor means as is the first claw.

Preferably the two claws are rigidly joined together or integrally formed as one component, so as to move together

Preferably the two claws are spaced apart in the direction of movement of the lengths of foodstuff so that one is ahead of the other in the direction of movement whereby if the leading claw engages the tail-end of a length of foodstuff being sliced the following claw will engage the next length of foodstuff in the said succession, upstream of the leading end face of the said next length of foodstuff.

In addition or instead another claw may be moved into contact with the foodstuff through a different gap in the first conveyor means, so as to engage an opposite face of the length of foodstuff from that engaged by the first claw.

Preferably the end face of the length of foodstuff that is to be sliced is viewed by at least one television camera, and a video signal obtained therefrom is processed by signal processing means, and logic and threshold criteria are applied to the processed signals to determine either the thickness of the next slice to be cut or whether the sliced foodstuff is of one of two or more different grades and whether it and preceding and/or following slices are to be diverted to one of two or more different packaging stations downstream of the second conveyor means.

Preferably the method also comprises the step of directing slices or stacks of slices on or from the second conveyor means, to one of two or more different buffer stores for packaging separately, according to grade.

Apparatus embodying the invention or a method embodying the invention may be used to slice sides of bacon.

The invention will now be described by way of example with reference to the accompanying drawings in which:-

Fig 1 is a side view of part of a meat slicing machine which includes a butt-end supporting claw,

Fig 2 shows the pneumatic circuit for operating the cylinders in Fig 1,

Fig 3 is a diagrammatic perspective view of the machine, showing the claw for holding on to the butt end of a side of bacon as it reaches the rotating blade, and

Fig 4 is a similar view of the machine of Fig 3 with the blade and collection conveyor shown in place,

Figs 5 and 6 are front elevation and top plan views of the claw assembly, and

Figs 7 and 8 are top plan and side elevation views of the skid plate.

In Fig 1 a lower conveyor 10 supports two sides of bacon, one behind the other, denoted by 12 and 14 respectively. The leading side of bacon has been largely sliced up by a rotating blade 16 by incrementally advancing the product after the blade leaves and before it re-engages the product - in manner known per se. The cut slices are not shown in Fig 1 but can be seen in Fig 4 at 18.

Although not visible in Fig 1 (but shown in Figs 3 and 4), two upper conveyors 74, 76 extend parallel to the lower conveyor 10 so that the meat is sandwiched and forcibly gripped between the upper and lower conveyors. Appropriate rotation of the conveyors will cause the two sides of bacon to move from right to left, with the trailing (or butt) end 13 of the first side of bacon 12 in contact with the leading end 15 of the following side of bacon 14, at a junction denoted by line 17.

As shown in Figs 3 and 4 the two upper conveyors are spaced apart so as to allow a claw assembly and support means therefor to protrude therebetween in a downward sense. The support means comprises a fixed upper support housing 20 below which is carried a lower support housing 22 at the front of which is carried a support plate 24 on which is removably secured the front end of a claw assembly 26 as by means of bolts or screws 27 (see Fig 3).

The claw assembly 26 must be capable of moving up and down and from right to left and back. To this end the housing 22 is secured to a plate 28 from which two parallel rods 30, 32 extend upwardly and are slidably received in two parallel sleeves in the housing 20.

In order to provide for up and down movement, a cylinder 34 is provided within the housing 20, to which air under pressure can be supplied to one end or the other, so as to displace a piston 36 upwardly or downwardly in the cylinder. The piston is connected via a rod 38 to the plate 28, so that displacement of the piston 36 in the cylinder 34 will cause the plate 28, (and housing 22 and claw assembly 26), to move up or down relative to the fixed housing 20.

Since the plate 24 and claw assembly 26 also needs to be able to move relative to the housing 22 to the left and right, plate 24 is attached to the left-hand ends of a pair of parallel rods 40, 42 which are slidably received in sleeves in the housing 22.

Movement of 24 relative to 22 in a direction from right to left is effected by engagement of the claw assembly 26 in the meat.

Movement in the reverse direction is effected by a cylinder 44 and piston 46 in the housing 20. Air under pressure can be supplied to port 48 to displace the piston 46 to the right, returning the claw assembly to its "home position".

As shown the claw assembly 26 includes fore and aft spikes 54, 56 each of which comprise two downwardly protruding spaced-apart prongs 53, 55 and 57, 59 (as can be seen from Fig 3), for engaging the meat.

With the piston 46 at the extreme right-hand end of cylinder 44, so that the claw assembly is fully retracted to the right, and with housing 22 raised so that plate 28 is in contact with the fixed housing 20, the prongs 53, 55 and 57, 59 are well clear of the upper run of the upper conveyor and therefore clear of the meat. In that position the claw assembly has no effect on the movement of the meat through the slicing station defined by the blade 16.

In use, as the butt end 13 of the leading side of bacon 12 starts to pass below the prongs of the left-hand spike 54, cylinder 34 is activated to force housing 22 in a downward direction, causing the prongs of spike 54 to impale the butt end 13. The spacing between the spikes 54 and 56 is selected so that the prongs 57, 59 of the upstream spike 56 become impaled just behind the leading edge of the following side of bacon 14.

Continued movement of the two pieces of meat to the left, under the action of the conveyors, causes the claw assembly 26 to be moved in the same direction, due to the prongs of the spikes 54, 56 being impaled in the two pieces of meat. In doing so plate 24 is similarly moved to the left, the two support rods 40, 42 attached to the plate 24, sliding in relation to the housing 22.

Mains air supply from a source 58 is supplied to a solenoid valve 63 (see Fig 2) to selectively supply air to ports 66 or 68 to move piston 36 up or down in cylinder 34, so as to raise or lower the housing 22 and therefore the claw assembly 26 carried thereby.

Valve 58 is arranged to vent the other port to atmosphere, to permit the piston 36 to move freely in 34.

When port 50 is pressurised by air from supply 61, via valve 65, piston 46 will be moved to its far left position.

When it is necessary to retract the claw assembly to the right, clear of the blade 16, air pressure is supplied from 61 to port 48 via valve 65. This causes piston 46 to move rapidly from left to right in cylinder 44. Since movement of 24 to the left will have moved rigid links 72, 73 to the left, link 73 will now be just to the rear of rod 47 of piston 46. Therefore applying air pressure to port 48 causes rod 47 to engage link 73 and push it (and therefore rods 40, 42 and plate 24) to the right. The claw assembly 26 is thus moved in the same direction away from the blade 16.

A control system 70 ensures that air is supplied to the valves 63, 65 and thereby to cylinders 34 and 44 in the correct order and at the correct times, so that the claw assembly 26 is lowered into the sides of bacon as the butt end of a leading side of bacon passes below the spike 54 and is raised and retracted just before the claw would enter the trajectory of the blade 16.

In particular control system 70 ensures air pressure is supplied to port 48 after piston 46 has been advanced fully to the right to return the claw assembly to its rest or home position so as to prevent forward creep of the assembly relative to the housing 20, but to remove air pressure from 50 as air is supplied to 66.

The link 73 can also be employed to indicate the position of the claw assembly relative to the fixed support housing 20, and therefore to the blade 16, and to this end sensors (not shown in Figs 1 and 2, but indicated in Figs 3 and 4) are also provided.

A first sensor 84 provides a signal along A to the control system 70 indicating the arrival of the junction 17 at a known position upstream of the blade 16 and a second sensor 86 provides a signal along B to the control system 70 indicating when the claw assembly has advanced towards the blade from its normal home position, by a pre-determined distance just less than the distance between the home position of the claw assembly and the rear of the blade trajectory.

Using the signal from the first sensor and the speed of advance of the conveyors, the control system is adapted to compute the time at which the junction 17 will arrive at a point some 40mm to the rear of the trajectory of the blade 16 at which time the control system delivers a signal to valve 63 to supply air from 58 to port 66 and thereby drive housing 22 and the claw spikes 54, 56 in a downward direction to engage the upper surface of each of the two pieces of meat as shown in Fig 1. Continued movement of the meat to the left draws the claw assembly in the same direction. If desired low pressure air may be supplied via valve 63 to port 48 (while port 50 is vented) by means of a further signal from control system 70.

A signal from the second sensor 86 along path B indicates that the claw advance cannot be allowed to continue (to prevent the claw assembly moving into the path of the blade). The control system 70 is therefore adapted to generate a further control signal for valve 63 to fully vent port 66 and supply high pressure air to port 68, to move piston 36 rapidly upwards in cylinder 34 so as to lift the spikes 54, 56 clear of the meat, and immediately afterwards generate another control signal for valve 65 to fully vent port 50 and supply high pressure air to port 48. This drives piston 46 rapidly to the right in cylinder 44, thereby to move the claw assembly rearwardly away from the blade trajectory.

A third sensor 87 can be used to indicate the position of vertical link 73 relative to the housing 20.

Cutting slices of bacon at high speed and accumulating predetermined numbers of slices in stacks just downstream of the blade requires the slicing to be interrupted after each stack is completed, to allow the completed stack to be conveyed away from the region immediately downstream of the blade, to leave the region clear for the next stack of slices to accumulate.

Where, as is normal blade rotation is contiguous, the interruption in the slicing (termed "slice denial"), requires the side of bacon which is being sliced to be moved backwards by a very small distance, typically a few mm, equivalent to the thickness of the slices being

cut, so that the end face is, out of the trajectory of the blade. This prevents the leading corner of the meat from being engaged by the blade.

This rearward movement of the meat during slice denial, is achieved by momentarily reversing the conveyor drive to move the meat rearwardly after the last slice for each stack is severed by the blade. However if slice denial is required after the claw has engaged the meat, there is a tendency for the small butt end (which may not be reliably gripped by the conveyor means) not to follow the conveyor movement and reverse away from the blade. By providing the second spike 56 physically joined to the first spike 54, the butt end 12 is securely held in place in front of and in contact with the following side of bacon 14, and even if the conveyors fail to grip the butt end 13 adequately to ensure that it is dragged rearwards during slice denial, the rigid link between the two spikes 54 and 56 ensures reliable withdrawal of the butt end, clear of the blade trajectory, during slice denial.

As shown in Figs 3 and 4 a second conveyor assembly extends above conveyor 10 and is urged towards 10 so as to grip the sides of bacon between the two conveyor runs. Drive means (not shown) rotates the endless belts making up the conveyors to index the sides of bacon 12, 14 through the slicing station containing the blade 10.

As already mentioned, the second upper conveyor is made up of two parallel spaced apart similar conveyors 74, 76 having regularly spaced spikes 78 which engage the upper surface of the meat.

As previously described, in order to lightly resist forward movement of the butt end 13 so as to keep it from being dragged forward by the repeated entries of the blade 16 just ahead of it, it is coupled to the following piece by the spikes 54 and 56 and tie rods 40 and 42.

Referring again to Figs 3 and 4 a support edge 80 is located between the end of conveyor 10 and the path of the blade 16 and the flat face of the latter is arranged to just wipe the front face of 80 after cutting through 12.

The blade trajectory is shown at 82 in Fig 3 and the blade 16 is shown more fully in Fig 4.

In Fig 3 the first sensor, denoted by reference 84, is shown positioned above conveyor 10 to sense when the leading end of the first side of bacon, moving towards the blade, reaches that point. This sensor 84 can in turn can be used to detect when the trailing end of that side of bacon also reaches that point, along conveyor 10.

Also in Fig 3 the second sensor, denoted by reference 86, is shown positioned so as to determine when claw assembly 26 has moved forward by a distance just less than the distance between the home position of the claw assembly and the blade 16. When it reaches that position a signal from the sensor to the control system triggers the supply of high pressure air to the pneumatic drive for raising 22 and immediately afterwards to the cylinder 44 to retract the raised claw away from the blade until plate 24 once again abuts housing 22.

Although not shown a further sensor may be provided which detects when the housing is in its fully elevated position and the claw spikes 54, 56 are therefore clear of the meat. By preventing the supply of high pressure air to port 48 of cylinder 44 until the appropriate sugnal is generated by this further sensor, so the claw will not be forcibly driven backwards until it is well clear of the meat.

An escapement 88 (see Fig 4) is located upstream of the sensor 84 and is also controlled by signals from the control system 70 (see Fig 2). The escapement includes an arm 90 which is movable into a lowered position shown (in which it will prevent a following side of bacon (not shown) from advancing further towards the rear of the preceding side of bacon 14), and into a raised position (not shown) which permits the following side of bacon (not shown) to move forwards to catch up the preceding side of bacon 14. The signal from the sensor 84 is used by the control system to raise the arm 90, so that the trailing end of the preceding side of bacon 14 has to have moved below 84 before the following side of bacon can catch up and make contact with the rear end of 14.

By preventing this contact from occurring until after the trailing end of 14 has been seen by 84, the sensor 84 can be relatively simple, and can comprise a laser light source below the path of the meat and a photosensor in 84 above the path of the meat. The leading end is detected by the interruption of the light to the sensor and the trailing end by the subsequent reinstatement of the light beam to the sensor as 14 moves forwardly beyond the path of the beam of light.

If the leading end of the following side of bacon were to have already caught up the trailing end of 14 before the latter had passed sensor 84 (and the light beam once again allowed to reach sensor 84), there would be no brief reinstatement of the light beam (indicating the passage of the trailing end of 14) to produce a trigger signal to the control system 70.

Fig 4 also shows a twin-jump conveyor 92 the first part of which 94 can move downwardly relative to the blade trajectory as the stack of slices 18 builds up thereon before being transferred to the second part of the conveyor 96.

In order to assist in separating the meat from the prongs of the spikes 54, 56 a skid plate 100 is fitted below the housing 20 so as to extend in the direction of travel of the meat. This can be seen in Fig 1, but is not shown in Figs 3 and 4.

The two prongs 53, 55 of the forward spike 54 of the claw assembly 26 can be seen in Figs 5 and 6. The skid plate shown in Figs 7 and 8 is shaped so as to fit between both pairs of prongs.

To this end, as best seen in Fig 7, the plate 100 is waisted at 102 and 104 to accommodate the spacing between the prongs 53, 55 and 57, 59 respectively, and elsewhere is of greater width as in regions 106, 108.

The plate 100 is supported from the fixed housing 20 by means of U-shaped brackets 110, 112 respectively, so that it does not move up and down as does the housing 22 and the spikes 54, 56 of the claw assembly. In this way, as the spikes are withdrawn from the meat, any tendency for the meat to rise up with the rising spikes is prevented.

Although not shown the plate 100 may be secured to the brackets 110, 112 by resilient spring means to allow for a small amount of thickness variation in the meat.

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CLAIMS

1. A slicing machine including a slicing station containing a rotatable blade for slicing blocks of foodstuff, wherein transport means is provided for gripping and moving the foodstuff blocks in a forward direction towards and through the slicing station which transport means comprises two part conveyor means adapted to grip blocks of foodstuff therebetween to move them towards the slicing station, one part including spaced apart sections defining a gap which will be substantially midway of a block of foodstuff when the latter is gripped between the two parts, and a movable claw is located upstream of the blade, and a drive means therefor is adapted to move the claw through the gap in one direction to engage a surface of a foodstuff block, and in the opposite direction clear of the block when not required, to provide when so engaged tail-end support for the block during slicing.

2. A machine as claimed in claim 1 wherein the claw drive means is controlled so as to move the claw into contact with the tail-end region at the rear end of a block of foodstuff, as the tail-end approaches the blade during operation of the machine.

3. A machine as claimed in claim 2 wherein the claw is adapted to travel with the tail-end in a direction towards the blade until the claw is just upstream of the blade, at which point the claw drive means is controlled to operate in an opposite sense to withdraw and retract the claw, to avoid the claw entering the trajectory of the blade.

4. A machine as claimed in any of claims 1 to 3 wherein the drive for the claw is pneumatic.

5. A machine as claimed in any of claims 1 to 4 wherein the claw drive comprises two pneumatic drives, in which one of the drives serves to drive the claw towards and away

from a block of foodstuff between the two parts of the conveyor means and the second serves to exert a rearwardly directed force on the claw.

6. A machine as claimed in claim 5 wherein the rearwardly directed force on the claw as the latter is advanced towards the blade is less than the tractive force exerted by the conveyor means but sufficient to resist the tendency for the blade to tear the tail-end of the foodstuff out of the conveyor means.

7. A machine as claimed in claim 6 wherein the rearwardly directed force is increased in magnitude when the claw is moved clear of the tail-end so as to accelerate the claw backwards away from the blade.

8. A machine as claimed in any of claims 1 to 7 further comprising a second similar claw adapted to engage an opposite face of the foodstuff block, and the conveyor means also defines a second gap through which the second claw can protrude.

9. A machine as claimed in claim 8 wherein a drive for the second claw is controlled to move it through its gap to engage the said opposite face of the block, at the same time as the first claw is moved in a direction to engage the other face of the block.

10. A machine as claimed in any of claims 1 to 9 wherein the or each claw comprises a single foodstuff engaging element.

11. A machine as claimed in claim 10 wherein the said element has two prongs spaced apart in a direction perpendicular to the movement of the foodstuff so as to engage two spaced apart regions of the foodstuff, to provide better support of the tail-end region of the block as it progresses towards the blade.

12. A machine as claimed in claim 10 or 11 wherein the or each claw comprises two such elements, one located upstream of the other, spaced apart in the direction of foodstuff travel, the spacing between the elememts being such that the downstream elememt will

engage the tail-end of a foodstuff block being sliced, and the upstream element will engage the following block of foodstuff just behind the leading face thereof, thereby tying the tail-end of the former to the leading end of the latter, so as to provide further support for the tail-end as it progresses towards the blade.

13. A machine as claimed in claim 12 wherein the second element is rigidly connected to or integrally formed with the first.

14. A machine as claimed in any of claims 1 to 13 wherein the two part conveyor means comprises upper and lower conveyor means and the upper conveyor means comprises two separate conveyors.

15. A machine as claimed in claim 14 wherein the two separate conveyors making up the upper conveyor means are relatively displaceable in at least a direction generally perpendicular to the plane of the lower conveyor means, so as to accommodate different thicknesses of foodstuff on either side of the gap.

16. A machine as claimed in claim 15 wherein resilient displacement means is provided for separately urging the two upper conveyors independently of each other in a direction towards the lower conveyor.

17. A machine as claimed in claim 16 wherein the displacement means exert substantially the same force on each of the two conveyors, so that the two conveyors squeeze the foodstuff between the upper and the lower conveyor means with substantially the same force on each side of the said gap.

18. A machine as claimed in any of claims 14 to 17 wherein each of the upper conveyors is driven from one rotational drive means so that both rotate at the same speed so as to advance foodstuff in a generally uniform manner towards the blade.

19. A machine as claimed in claim 18 wherein the lower conveyor means is also driven from the said one rotational drive means

20. A machine as claimed in any of the preceding claims further comprising a control system for controlling the operation of the machine using signals which identify the positions of the leading and trailing ends of blocks of foodstuff to be sliced thereby, together with signals indicating the linear advance of each block derived from the movement of the conveyors.

21. A machine as claimed in claim 20 which includes a sensor upstream of the slicing station to provide a first signal when the leading end of a first block of foodstuff to be moved towards the blade passes the sensor, and to provide a second signal when the trailing end of that first block passes the sensor, the first and second signals being supplied to the control system.

22. A machine as claimed in claim 21 further comprising an escapement under the control of the control system, which escapement operates so as only to allow a subsequent block of foodstuff to move up to and abut the trailing end of a preceding block of foodstuff after the trailing end of that preceding block has passed the sensor and a second signal has been produced by the sensor for that preceding block.

23. A machine as claimed in any of the preceding claims in which the line of travel of the foodstuff blocks gripped by the conveyor means is at 90° to the plane of rotation of the blade, and the latter subtends an angle of approximately 60° to the vertical.

24. A machine as claimed in any of claims 1 to 23 wherein a so-called twin jump conveyor is provided beyond the blade to collect and remove stacks of slices as soon as they are formed downstream of the blade.

25. A machine as claimed in any of claims 5 to 24 wherein the air is supplied to the claw drive via valve means from a common source or from separate sources of air under pressure.

26. A machine as claimed in claim 25 wherein the valve means comprises solenoid valves.

27. A machine as claimed in claim 25 or 26 wherein the or each source of air pressure for the drives is adjustable to deliver an appropriate pressure to each claw drive.

28. A machine as claimed in any of claims 14 to 27 further comprising plate means located in a generally fixed manner in spaced relation from the lower conveyor means, to engage the upper surface of blocks of foodstuff conveyed thereunder and prevent the foodstuff from lifting as the claw is lifted.

29. A machine as claimed in any of claims 25 to 28 further comprising a control system which controls the operation of the feed conveyor means, the slicing blade, the engagement and withdrawal of the claw, and the feeding of blocks of foodstuff product, and is also adapted to control the valve means synchronously with operation of the machine and particularly the movement of the claw.

30. A method of slicing a succession of lengths of foodstuff using a rotating blade in a slicing station, wherein a first conveyor means incrementally moves the foodstuff by applying a tractive force F_1 thereon towards the blade so as to cause successive parts of the foodstuff to protrude into the path of the blade so as to be severed therefrom as the blade passes therethrough, and a second conveyor means collects the slices of foodstuff and conveys them away from the slicing station, comprising the further steps of:-

(1) sensing when the leading edge of a length of foodstuff to be sliced passes a given position along the path of the first conveyor means upstream of the cutting station and generating a leading edge signal,

(2) sensing when the trailing edge of the same length of foodstuff also passes the said given position, and generating a trailing edge signal, to allow the length to be computed,

(3) computing the length of the foodstuff being sliced from the distance travelled by the first conveyor means after the leading edge signal,

(4) determining from the computed length value and the movement of the conveyor means, when the trailing edge is a distance of N mm upstream of the blade trajectory,

(5) driving a claw through a gap in the first conveyor means at a position Mmm ($M < N$) upstream of the blade to engage and thereafter move with the foodstuff, and

(6) sensing the position of the claw and retracting it from the foodstuff before the claw reaches the blade.

31. A method as claimed in claim 30 wherein the claw is pneumatically driven towards and away from the foodstuff.

32. A method as claimed in claim 30 or 31 wherein pneumatic force is also employed to move the claw rearwardly away from the foodstuff.

33. A method as claimed in any of claims 30 to 32 further comprising the step of applying a force F_2 to resist the forward motion of the claw towards the blade, where F_2 is less than F_1, so that there is still a net force acting on the foodstuff to incrementally move it towards the blade.

34. A method as claimed in any of claims 30 to 33 wherein the leading and trailing edges of each length of foodstuff are detected using a laser beam and a photosensitive device.

35. A method as claimed in claim 34 wherein a following length of foodstuff is prevented from moving into abutment with the trailing end of the length being sliced until after the trailing edge of the latter has been detected.

36. A method as claimed in any of claims 30 to 35 which further includes the step of successively lowering the second conveyor means relative to the blade as slices of foodstuff are deposited thereon, so as to enable a plurality of slices to be stacked one above the other on the second conveyor means so that the upper end of the stack does not prevent the slices from leaving the blade and falling onto the stack.

37. A method as claimed in claim 36 wherein the second conveyor means is operated to convey a stack of slices away from the region of the blade when a predetermined number of slices P, or a given weight of foodstuff W, has been accumulated thereon.

38. A method as claimed in claim 37 wherein a counter counts the number of slicing cuts by the blade and resets when P is reached, and the resetting of the counter triggers the second conveyor means to move the stack laterally away from the blade.

39. A method as claimed in claim 37 wherein a weighing device is associated with the second conveyor means and the latter is operated to move the foodstuff laterally away from the blade when the weight detected by the weighing device reaches W.

40. A method as claimed in claim 37, 38 or 39 wherein the second conveyor means is in two parts and one part acts to collect slices until the P or W criterion is reached, whereafter a second part takes over to collect slices from the slicing station while the first part conveys away the stack of slices accumulated thereon, the two parts alternating in synchronism to allow a substantially continuous stream of slices from the slicing station to be handled.

41. A method as claimed in any of claims 30 to 40 which involves the further step of moving a second claw into contact with the foodstuff at the same time as the first claw engages the foodstuff, the second claw also moving with the foodstuff, and also being retracted away from the foodstuff before the claw reaches the blade.

42. A method as claimed in claim 41 wherein the second claw is moved into contact with the foodstuff through the same gap in the first conveyor means as is the first claw.

43. A method as claimed in claim 41 or 42 wherein the two claws are rigidly joined together or integrally formed as one component, so as to move together

44. A method as claimed in claim 41, 42 or 43 wherein the two claws are spaced apart in the direction of movement of the lengths of foodstuff so that one is ahead of the other in the direction of movement whereby if the leading claw engages the tail-end of a length of foodstuff being sliced the following claw will engage the next length of foodstuff in the said succession, upstream of the leading end face of the said next length of foodstuff.

45. A method as claimed in claim 41 wherein another claw is moved into contact with the foodstuff through a different gap in the first conveyor means, so as to engage an opposite face of the length of foodstuff from that engaged by the first claw.

46. A method as claimed in any of claims 30 to 45 wherein the end face of the length of foodstuff that is to be sliced is viewed by at least one television camera, and a video signal obtained therefrom is processed by signal processing means, and logic and threshold criteria are applied to the processed signals to determine either the thickness of the next slice to be cut or whether the sliced foodstuff is of one of two or more different grades and whether it and preceding and/or following slices are to be diverted to one of two or more different packaging stations downstream of the second conveyor means.

47. A method as claimed in any of claims 30 to 46 which also comprises the step of directing slices or stacks of slices on or from the second conveyor means, to one of two or more different buffer stores for packaging separately, according to grade.

48. Apparatus as claimed in any of claims 1 to 29 or a method as claimed in any of claims 33 to 50 when used to slice sides of bacon.

49. Apparatus and methods for controlling foodstuff while being sliced and for slicing foodstuff substantially as described herein and/or with reference to and as illustrated in the accompanying drawings.

Application No:	GB 0305494.7	**Examiner:**	Robert Black
Claims searched:	1-49	**Date of search:**	10 June 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
A		US 4583435 A	(FESSIER) especially figures 2 and 3, column 4 lines 8-41, and column 4 line 67 to column 5 line 17

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

A4C; B8A

Worldwide search of patent documents classified in the following areas of the IPC[7] :

B26D; B65G

The following online and other databases have been used in the preparation of this search report :

EPODOC; WPI; PAJ